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The Invasion of a Missouri River Alluvial Flood Plain.

BY HERBERT C. HANSON.

INTRODUCTION

An interesting invasion of an alluvial bank, formed in the spring of 1916 by the Missouri river, near Peru, Nebraska, was studied during August and September, 1916. The vegetation on new land formed by river or lake activity has been the theme of several writers and is summarized by Clements (2). The plants mentioned in this article were named according to the second edition of Britton and Brown's Illustrated Flora. The identification of difficult species was verified by comparison with preserved specimens in the herbarium of the University of Nebraska.

DESCRIPTION OF THE ALLUVIAL BANK

The Missouri river, colored yellow by the enormous load of fine soil carried in suspension, overflows its banks every spring. As the flood recedes great quantities of silt, clay and sand, besides trees, logs, brush and herbaceous plants are deposited on the flood plain. An area, about half a mile long and varying in width from about fifty feet to several hundred feet, forming the bank on the Nebraska side of the river, was denuded of vegetation by the spring flood of 1916. Most of the area was approximately flat, in some places sloping gently to the river's edge, in other places forming a vertical bank of three to five feet.

The soil was very fine, composed of a mixture of fine sand, silt and clay. Frequently, scales formed on the surface and cracks from six inches to thirty inches deep, and up to six inches wide, formed in the more clayey soil.

THE INVASION

1—BRUSH PILES

Logs, brush and other debris were scattered over the bank after the water had receded. Fruits, seeds, roots, rootstocks, stems, and, in places, entire plants were held by the brush, giving rise to clumps of vegetation.

Equisetum was usually restricted to these brush piles, growing from rootstocks. Willows, growing from roots and stems, were also common. Other plants found growing in the brush were

Cyperus erythrorhizos, *Persicaria lapathifolia*, *Bidens frondosa*, *B. cernua*, *Xanthium commune*, *Panicum dichotomiflorum*, *Chaetochloa glauca*, *Scirpus validus*, *Acnida tuberculata*, and *Echinochloa crus-galli*.

2.—WATER LEVEL ZONES

Figure 3 illustrates how sticks and other brush were deposited on the shore just beyond the reach of the waves.

The seeds and fruits caught in the brush were so abundant that they could be gathered by the handful. As the flood water receded new water levels were formed. The duration of the water at a certain level determined, largely, the amount of brush and seeds deposited at that level. The number of seeds deposited determined the width and the density of the vegetative zone formed from the germination and growth of the seeds at the water level. This accounts for the variation in the number of plants in the various zones as shown in figure 4.

The number of vegetative zones on the area varied according to the degree of slope. Where the slope was gradual, as in figure 4, as high as 15 zones were found; but where the slope was vertical no zones were found. The most abundant plant in these zones was *Cyperus erythrorhizos*. The brown color of this species caused the zones to form a striking contrast with the light gray of the soil. *Bidens frondosa* and *B. cernua* were also abundant. The following plants occurred frequently; *Radicula palustris*, *Verbesina alba*, *Strophostyles helvola*, *Salix interior*, *S. cordata*, *Persicaria pennsylvanicum* and *Potentilla paradoxa*.

3.—LEVEL AREAS.

The vegetation of the level areas varied considerably. In some places seedling willows and poplars were abundant, and various grasses and herbs occurred sparingly among them. In other places willows, grasses and herbs, but no poplar, were found.

In other places only herbs and grasses were growing. (Fig. 1.) The absence of willows or poplars on certain areas is due to the fact that these areas were still covered by water when the seeds of these trees were migrating. On the more sandy areas were found usually: *Eragrostis hypnoides*, *E. purshii*, and *Panicum capillare*. Other plants occurring on the levee areas were *Cyperus erythrorhizos*, *Bidens cernua*, *B. frondosa*, *Radicula palustris*, *Panicum dichotomiflorum*, *Rumex crispus*, *Persicaria lapathifolia*, *P. Pennsylvanica*,

and *Potentilla paradoxa*. The walls of the large cracks in the more clayey areas were frequently covered with a green lining of *Vaucheria* and various diatoms. A species of *Riccia*, a flat, circular, well-rooted plant, was usually the first to grow on the newly exposed land.

Table 1. Showing the plants found growing on the alluvial bank, their abundance, their location and the kind of propagule.

SPECIES	ABUNDANCE	OCCURRENCE	PROPAGULE
<i>Cyperus erthrorhizos</i> Muhl	very abundant	zones brush level areas	achene
<i>Bidens frondosa</i> L.	abundant	zones brush level areas	barbed awn achene
<i>Bidens cernua</i> L.	very abundant	zones brush level areas	barbed awn achene
<i>Strophostyles helvola</i> (L.) Britton.	very rare	zones	pod seed
<i>Scirpus validus</i> Vahl.	infrequent	brush	rootstock achene
<i>Eragrostis hypnoides</i> (Lam.) B.S.P.	infrequent	sandy areas	grain
<i>Eragostis purshii</i> Schrad.	frequent	level areas	grain
<i>Chatochloa glauca</i> (L.) Scribn.	infrequent	brush	grain panicle
<i>Radicula palustris</i> (L.) Moench	abundant	zones level areas	pod seed
<i>Panicum capillare</i> L.	infrequent	level areas	grain panicle
<i>Panicum dichotomoflorum</i> Michx.	infrequent	brush level areas	grain
<i>Verbesina alba</i> L.	infrequent	zones	achene
<i>Persicaria lapathifolia</i> (L.) S. F. Gray	infrequent	brush level areas	achene
<i>Persicaria pennsylvanica</i> (L.) Small.	frequent	zones level areas	achene
<i>Acnida tuberculata</i> Moq.	very rare	brush	utricle seed
<i>Echinochloa crus-galli</i> (L.) Beauv.	infrequent	brush	grain

<i>Potentilla paradoxa</i> Nutt.	rare	zones level areas	achene
<i>Xanthium commune</i> Britton	very rare	brush	spiny bur achene
<i>Rumex crispus</i> L.	frequent	zones level areas	winged achene
<i>Equisetum</i> sp.	infrequent	brush	spore rootstock
<i>Vaucheria</i> sp.	abundant	cracks	filament spore
Diatoms	abundant	cracks	entire plant spore
<i>Riccia</i> sp.	abundant	moist soil	entire plant spore
<i>Salix interior</i> Rowlee.	very abundant	level areas brush zones	entire plant stem, root seed
<i>Salix cordata</i> Muhl.	rare	zones	stem root seed
<i>Populus deltoides</i> Marsh.	frequent	level areas zones	seed

SUMMARY.

1. The invasion of an alluvial bank formed by the Missouri river, near Peru, Nebraska, was studied during August and September, 1916.

2. The soil of this bank consisted of a mixture of very fine sand, silt and clay.

3. Deep cracks occurred frequently in the clayey part. *Vaucheria* and diatoms often grew on the moist, shaded walls of these cracks.

4. The agents of invasion were water, wind and possibly under certain conditions, birds and other animals.

5. The first plant, usually, to grow on the new land was a *Riccia*.

6. Seeds and fruits, deposited with the brush at the water levels as the flood water receded, formed well-defined zones.

7. As the water receded from the level areas, seeds and fruits were left scattered on the wet soil, giving rise to a very open form of vegetation. This open vegetation was broken in places by piles

of brush. Growing from the seeds, fruits, roots, stems and entire plants, which were held by the brush, were found the largest plants on the bank.

8. Seeds of willow and poplar were carried in by the wind.

9. The order of the succession after the recession of the water was *Riccia*——>ruderal herbs and grasses——>seedling willows and poplars——>zone of young willows and poplars——>flood plain forest of willows, poplars, and some elm, ash and sycamore.

REFERENCES

1. Braun, E. Lucy. The physiographic ecology of the Cincinnati region. Ohio State Univ. Bull. 20; 116-211, 1916. P. 188.
2. Clements, F. E. Plant Succession. Publ. 242, Carnegie Insti. of Wash. Washington, D. C. 1916.
3. Elmore, C. J. The first year's flora of a dried-up mill-pond. Proc. Nebr. Acad. Sci. 7; 29. 1901.
4. Soil survey of Nemaha County, Nebraska. Bur. of Soils, U. S. Dept. of Agric. Washington, D. C. 1916.

DESCRIPTION OF FIGURES.

FIG. 1.—Deep cracks in alluvial clay caused by the evaporation of water. *Persicaria Pennsylvanica*, *Radicula palustris*, *Rumex crispus*, and *Bidens cernua* are the more common plants. *Vaucheria* and diatoms form a green lining over the damp walls of numerous cracks.

FIG. 2.—Plants growing from seeds, fruits, stems, roots, or entire plants caught by the brush. *Salix cordata* in background and *S. interior* in foreground growing from branches. *S. interior* in center from a root. The other plants are *Panicum dichotomiflorum*, *Equisetum* at extreme right growing from rootstocks, *Persicaria lapathifolia*, *Bidens frondosa*, and *Xanthium commune*.

FIG. 3.—Showing the deposition of brush on the shore just beyond the reach of the waves. Large quantities of seeds and fruits were held in the brush.

FIG. 4.—The seeds, deposited as shown in Fig. 3., have given rise to these water level zones. The most abundant plants are *Cyperus erythrorhizos*, *Bidens cernua*, and *B. frondosa*. Other plants are *Salix interior*, *Populus deltoides*, *Rumex crispus*, *Verbesina alba*, *Radicula palustris* and *Potentilla paradoxa*.

FIG. 5.—Showing the vegetation on a level area of an alluvial bank in Sept., 1916. Willow seedlings are the most abundant plants. The dark-colored plant is *Cyperus erythrorhizos*. The light-colored plant is *Eragrostis purshii*.

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Plants of Blue Rapids and Manhattan, Kansas.----Corrections and Index to Common Names.

BY O. A. STEVENS.

Corrections.

Page 73 to 87, heading, for Blue Island, read Blue Rapids.

- " 73 line 18, insert period after Link.
- " 74 " 27, for *halépense*, read *Halepense*.
- " 75 " 9, " *scribnerianum*, read *Scribnerianum*.
- " 75 " 13, " *glauca*, read *glauca*.
- " 77 " 1, " Oast, read Oats.
- " 77 " 18, " *Schrad.*, read *Schrad*.
- " 79 " 11, Add: June 10.
- " 81 " 29, for *officinale*, read *officinalis*.
- " 82 " 16, " Places, read places.
- " 84 " 31, " *patientia*, read *Patientia*.
- " 87 " 30, " *Ranunculus*, read *Ranunculus*.
- " 98 " 6, " *Willd.*, read *Willd*.
- " 100 " 21, " *occidentolis*, read *occidentalis*.
- " 101 " 3 from bottom, for 25 (23), read 20 (19).
- " 101 " 19, for *Amygdalius*, read *Amygdalus*.
- " 102 " 25, " *floribnnda*, read *floribunda*.
- " 103 " 25, " *grandflora*, read *grandiflora*.
- " 103 " 33, " 25 (23), read 20 (22).
- " 104 " 9, " (L. 1), read (L.).
- " 115 " 14, " *L.*, read *L*.
- " 115 " 27 and 29, for *Penstemon*, read *Pentstemon*.
- " 117 " 12, for *L.*, read *L*.
- " 117 " 6 from bottom, for *Cucurftla*, read *Cucurbita*.
- " 119 " 13, insert at beginning: Manhattan.
- " 120 " 2, for Aug. 16, read Aug. 15.
- " 120 " 5, " sometime, read some time.
- " 122 after line 22 insert: *Bidens acuta* (Wiegand) Britton. Riverbanks.
Common.
- " 124 line 32, for *Halpense*, read *Halepense*.
- " 124 add at bottom of page: *Potamogeton foliosus* Raf.
- " 128 line 8 from bottom, for D. C., read DC.



Fig. 1

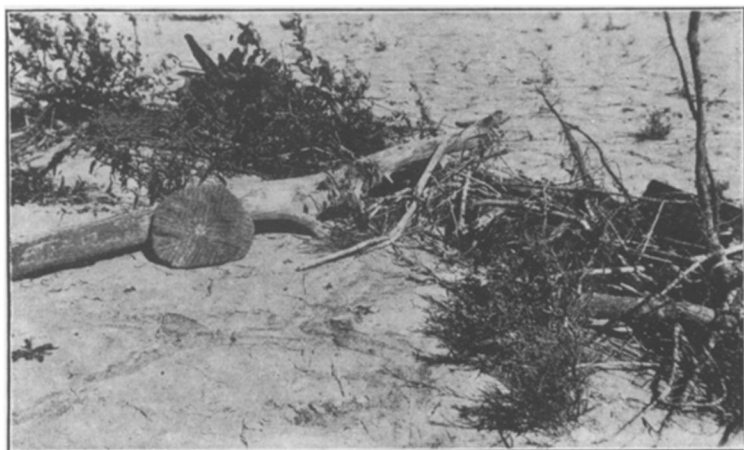


Fig. 2

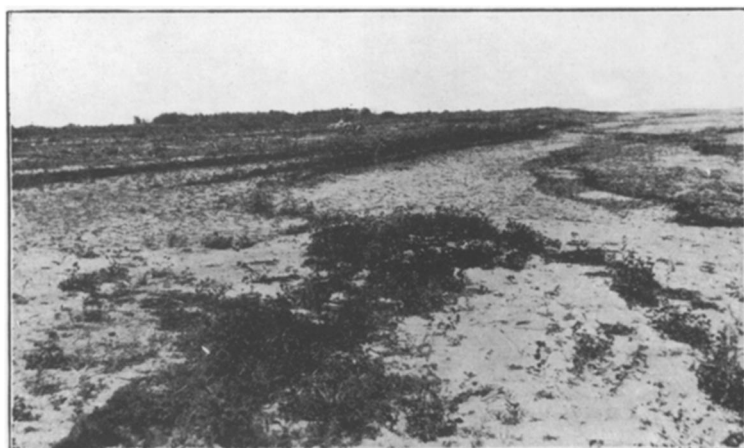


Fig. 4

PLATE I.—Hanson on Invasion of a Missouri River Alluvial Flood Plain.



Fig. 3

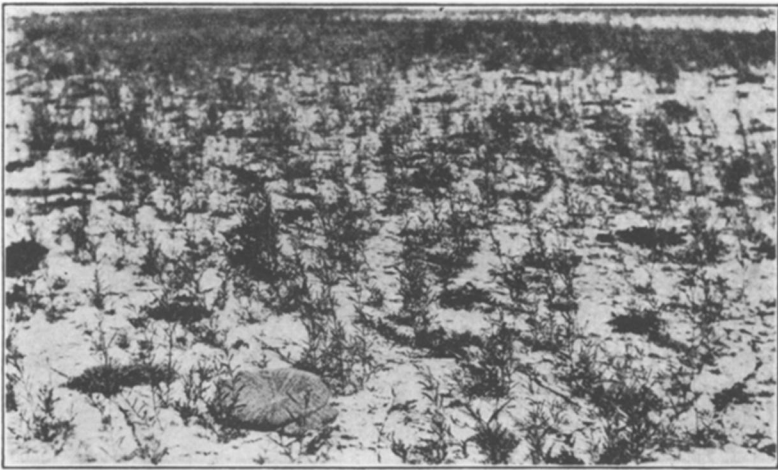


Fig. 5

PLATE II.--Hanson on Invasion of a Missouri River Alluvial Flood Plain.